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DEPARTEMENT VAN  
HANDEL EN NYWERHEID



PCT/ZA03/00011

*Certificate*  
PATENT OFFICE  
REPUBLIEK VAN SUID-AFRIKA

DEPARTMENT OF TRADE  
AND INDUSTRY

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the documents annexed hereto are true copies of:

Application forms P.1 and P.2, provisional specification and drawings  
of South African Patent Application No. 2002/0578 as originally  
filed in the Republic of South Africa on 23 January 2002 in the name  
of Tsitsikamma Trust for an invention entitled: "ANALYSER  
ARRANGEMENT".

Geteken te  
Signed at

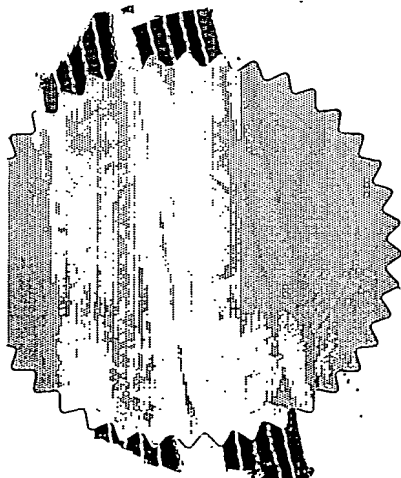
PRETORIA

in die Republiek van Suid-Afrika, hierdie  
in the Republic of South Africa, this

15th

dag van  
day of

April 2003



*[Signature]*  
Registrateur van Patente  
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REPUBLIC OF SOUTH AFRICA				REGISTER OF PATENTS				PATENTS ACT, 1978				
Official Application No.:				Lodging date: Provisional				Acceptance date:				
21	01	2002/0578		22	2002-01-23		47					
International Classification:				Lodging date: Complete				Grant date:				
51				22								
Full name(s) of applicant(s)/Patentee(s):												
71	Tsitsikamma Trust											
Applicants substituted								Date registered				
71												
Assignee(s):								Date registered				
71												
Full name(s) of inventor(s)												
72	Francois Eberhardt DU PLESSIS											
Priority claimed												
33	Country	31	Number	32	Date							
Title of invention												
54	ANALYSER ARRANGEMENT											
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Patent of addition No.				74					Date of any change			
Fresh application based on								Date of any change				

## PATENT APPLICATION AND ACKNOWLEDGEMENT

[Section 30(1) - Regulation 22]

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate.

21	01	Official Application No.: <b>2002/0578</b>	DrG Ref.: 598914
71	Full name(s) and address(es) of applicant(s): Tsitsikamma Trust Rokewood Avenue Die Boord Stellenbosch 7600		
54	Title of invention: ANALYSER ARRANGEMENT		
The applicant claims priority as set out on the accompanying form P2. The earliest priority claimed is:			
This application is for a patent of addition to Patent Application No.			21 01
This application is a fresh application (section 37) based on Application No.			21 01

## THIS APPLICATION IS ACCOMPANIED BY THE FOLLOWING:

- |                                     |     |    |  |                 |
|-------------------------------------|-----|----|--|-----------------|
| <input checked="" type="checkbox"/> | 1.  | P6 | Provisional specification                          | Pages: 10       |
| <input type="checkbox"/>            |     | P7 | Complete specification                             | Pages: 2 copies |
| <input checked="" type="checkbox"/> | 2.  |    | Drawings   | Sheets: 2       |
| <input type="checkbox"/>            | 3.  | P8 | Publication particulars and abstract in duplicate. |                 |
| <input type="checkbox"/>            | 4.  |    | Drawing for abstract                               |                 |
| <input checked="" type="checkbox"/> | 5.  |    | An assignment of invention                         |                 |
| <input type="checkbox"/>            | 6.  |    | Certified priority document(s)                     |                 |
| <input type="checkbox"/>            | 7.  |    | Copy of Form P2 and SA Patent Application No       |                 |
| <input type="checkbox"/>            | 8.  |    | Translation of the priority document(s)            |                 |
| <input type="checkbox"/>            | 9.  |    | An assignment of priority rights                   |                 |
| <input checked="" type="checkbox"/> | 10. | P3 | Declaration and power of attorney on form P3       |                 |
| <input type="checkbox"/>            | 11. | P4 | Request for ante-dating on form P4                 |                 |
| <input type="checkbox"/>            | 12. | P4 | Request for classification on form P9              |                 |
| <input checked="" type="checkbox"/> | 13. | P2 | Register sheet (in duplicate)                      |                 |

Date: 23 January 2002

  
**DR GERNTHOLTZ**  
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REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT Official date stamp  <b>2002 -01- 23</b>	REGISTRATEUR VAN PATENTE, MOEDELLE, HANDELSMERKE EN OUTEURSREG
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## DECLARATION AND POWER OF ATTORNEY

[Section 30 - Regulations 8, 22(1)(C) and 33]

21	01	Patent/Application No. <b>2002/0578</b>	DrG Ref: <b>598914</b>				
22		Lodging Date: <b>2002-01-23</b>					
71	Full name(s) of applicant(s): <b>Tsitsikamma Trust</b>						
72	Full name(s) of inventor(s): <b>Francois Eberhardt DU PLESSIS</b>						
Earliest priority claimed		33	Country	31	Number	32	Date
		I					
54	Title of Invention: <b>Analyser Arrangement</b>						

I/We hereby declare that:

- ☐ (Applicant(s) = Inventor(s))  
I/We am/are the inventor(s) of the abovementioned invention and the applicant(s) mentioned above and have knowledge of the facts herein stated in my/our capacity as inventor(s) and applicant(s).
- ☒ (Applicant(s) = Assignee(s) of inventor(s))  
The inventor(s) of the abovementioned invention is/are the person(s) named above; and the applicant(s) has/have acquired the right to apply by virtue of an assignment from the inventor(s).  
I/We have been authorised by the applicant(s) to make this declaration and have knowledge of the facts herein stated in my/our capacity as indicated below.
- ☒ To the best of my/our knowledge and belief, if a patent is granted on the application, there will be no lawful ground for the revocation of the patent.
- ☐ This is a convention application and the earliest application from which priority is claimed as set out above is the first application in a convention country in respect of the invention claimed in any of the claims.
- ☒ The partners and the qualified staff of the firm of DR GERNTHOLTZ, Patent Attorneys, Cape Town are authorised, jointly and severally, with powers of substitution and revocation, to represent the applicant(s) in this application and to be the address for service of the applicant(s) while the application is pending and after a patent has been granted on the application.

Signature: 1. *F. du Plessis* 2. \_\_\_\_\_ 3. \_\_\_\_\_Name: F. du Plessis  
Please print name of signatory in block letters.Capacity: \_\_\_\_\_  
Please indicate capacity (e.g. president, director, secretary) of signatory if signing on behalf of a company or corporation or any other legal body.Date: 23 Jan 2002Place: Cape Town

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REPUBLIC OF SOUTH AFRICA  
PATENTS ACT, 1978  
PROVISIONAL SPECIFICATION

[Section 30(1) - Regulation 27]

21	01	Official Application No.: <b>2002/0578</b>	DrG Ref.: 598914
22	Lodging date: 2002-01-23		
71	Full name(s) of applicant(s): Tsitsikamma Trust		
72	Full name(s) of inventor(s) Francois Eberhardt DU PLESSIS		
54	Title of invention ANALYSER ARRANGEMENT		

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DrG REF 598914spec

## TITLE OF INVENTION

Analyser arrangement.

## FIELD OF INVENTION

5 The present invention relates to analyser arrangements.

More particularly, the present invention relates to analyser arrangements for online spectral analysis of mineral streams.

## BACKGROUND TO INVENTION

10 In order to control mineral processing plants, determination of mineralogical composition of various streams in the plant is required. Known methods include grain-counting techniques. However, in some cases data automation of this process does not produce reliable results and only manual methods prove to be reliable. Furthermore, the determination of elemental chemical composition alone (XRF - X-ray  
15 fluorescence spectrography) does not provide all the necessary information. Furthermore, due to the variability in chemical composition it is not possible to utilise this method for the exact description of mineralogical composition. Accordingly, automation of the mineral analysis procedure is required.

20 It is an object of the invention to disclose an analyser arrangement for online spectral analysis of mineral streams.

## SUMMARY OF INVENTION

According to the invention, an analyser arrangement for determining the composition of a mineral stream, includes online spectral analysis means for determining the composition of a mineral stream.

5 Also, according to the invention, a method of determining the composition of a mineral stream, includes the steps of

- (a) illuminating a mineral stream to cause light reflection therefrom;
- (b) sensing the light reflected by the mineral stream; and
- 10 (c) analysing the light reflected by the mineral stream by spectral analysis to determine the composition of the mineral stream.

The online spectral analysis means may include

- (a) illumination means for illuminating the mineral stream to cause light reflection therefrom;
- 15 (b) sensing means for sensing the light reflected by the mineral stream;
- (c) a spectrometer for analysing information supplied by the sensing means, and thereby determining the spectral distribution of the reflected light; and
- 20 (d) a data processor for evaluating information supplied by the spectrometer and thereby determining the composition of the mineral stream.

The illumination means and sensing means may be associated with a probe.

A mechanical shield may be provided to shield the probe from the mineral stream.

- 5 The mechanical shield may include scraping means for scraping the surface of the mineral stream for facilitating internal illumination and sensing of the mineral stream.

A light shield may be provided to limit external light from influencing the sensing of the sensing means.

- 10 The probe may include optical fibres.

The illumination means may include illuminating fibres.

The sensing means may include sensing fibres.

The illumination means may emit UV (ultra-violet), and/or visible and/or IR (infra-red) light.

- 15 The processor may identify the spectral identities of minerals in the mineral stream.

The processor may calculate the quantity of each mineral in the mineral stream.

- 20 The analyser arrangement may provide real-time information of the mineral composition.

The analyser arrangement may be provided with operation means for automatic control of a mineral processing plant.



The analyser arrangement may be calibrated by means of a bench-top mineral analyser.

The analyser arrangement may be provided with an additional light source.

## 5 BRIEF DESCRIPTION OF DRAWINGS

The invention will now be described by way of example with reference to the accompanying schematic drawings.

In the drawings there is shown in:

- Figure 1: a perspective view of an analyser arrangement in accordance  
10 with the invention;
- Figure 2: a front view of the analyser arrangement seen along arrow II  
in Figure 1;
- Figure 3: a top view of the analyser arrangement seen along arrow III  
in Figure 1; and
- 15 Figure 4: a sectional side view of the analyser arrangement seen along  
arrows IV-IV in Figure 3.

## DETAILED DESCRIPTION OF DRAWINGS

Referring to Figures 1 to 4, an analyser arrangement for online analysis of a mineral stream in order to determine the composition of the mineral  
20 stream, generally indicated by reference numeral 10, is shown.

The analyser arrangement 10, in use located in proximity of mineral conveying means 12, such as a conveying belt, and conveying a mineral

stream 14 to be analysed, includes a probe 16 positioned close to the moving mineral stream 14. The mineral stream 14 in the embodiment example consists of dry minerals.

5 The probe 16 is provided with two types of optical fibres (not shown), illuminating fibres and sensing fibres. Light emitted by the illuminating fibres is selectively reflected by the minerals in the mineral stream 14, and the reflected light is picked up by the sensing fibres, whereafter information is sent via the probe output 18 to a spectrometer (not shown) which senses the spectral distribution of the light reflected by the minerals  
10 in the mineral stream 14, and transmits the output to a data processor (not shown). The output of the data processor includes seven 4-20 mA signals, each corresponding to a percentage of mineral occurrence.

The light emitted by the illuminating fibres include visible and NIR (near infra-red) reflected according to the mineral composition and impurities  
15 therein. Accordingly, the spectrometer is classified as a visible and NIR spectrometer.

The processor thereafter identifies the digital output or spectral "fingerprints" of the different minerals in the mineral stream 14, and calculates the abundance of each mineral of concern in the mineral  
20 mineral 14. The processor output may include an operator user-friendly interface.

Furthermore, the analyser arrangement 10 is provided with an additional light source 20 for illuminating the mineral stream 14.

Also, the analyser arrangement 10 is provided with a mechanical shield 22  
25 to shield the probe 16 from the mineral stream 14, i.e. for scraping the

surface of the mineral stream 14 to enable the probe 16 to internally illuminate the mineral stream 14.

Calibration of the analyser arrangement may be achieved by means of a bench-top analyser model where changes in the mineralogy of the mineral stream 14 occurs.

The implementation of the analyser arrangement is achieved in various phases, namely:

- (a) Amenability study;
- (b) Desktop analyser arrangement; and
- (c) ON-line analyser arrangement.

During the amenability study phase, a representative set of mineral samples is obtained by the user. The number of known samples required at this stage is  $n=(m+1)^2$ , where  $n$  is the number of samples, and  $m$  is the number of mineral mixtures to be differentiated. The accuracy of the composition of these samples determines the final accuracy of the analyser arrangement according to the invention. An analysis and training set for the specific set of minerals is performed, and an expected level of accuracy is calculated.

During the desktop analyser arrangement phase, a desktop analyser, set up according to the results of the amenability study, is constructed and includes:

- An industrial computer preloaded with analysis and data storage software,

- A spectrometer,
- A light source, and
- A probe assembly.

Initially, the system is provided with rough calibration and tuning,  
5 however final tuning has to be performed over a time span, for example  
four to eight weeks, in order to achieve full accuracy.

The spectral data of several samples and the known values for these  
samples are determined and thereafter utilised for obtaining final tuning  
parameters, to be loaded in the bench top model.

- 10 Finally, during the on-line analyser arrangement phase, the on-line  
analyser arrangement in accordance with the invention is constructed.

Accordingly, the analyser arrangement 10 in accordance with the invention provides an arrangement and method to achieve accurate and frequent measurements of mineral streams in mineral processing operations. The on-line analyser arrangement provides mineral  
5 concentrator operations with real-time information of the mineral composition of mineral streams and provides the option of automatic control.

Date: 23 January 2002

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20 DrG Ref: 598914  
598914spec

**LIST OF REFERENCE NUMERALS**

- 10   Analyser arrangement
- 12   Mineral conveying means
- 14   Mineral stream
- 5   16   Probe
- 18   Probe output
- 20   Light source
- 22   Mechanical shield

TSITSIKAMMA TRUST

NO OF SHEETS 2  
SHEET NO 1  
DRG Ref.: 598914

FIG. 1

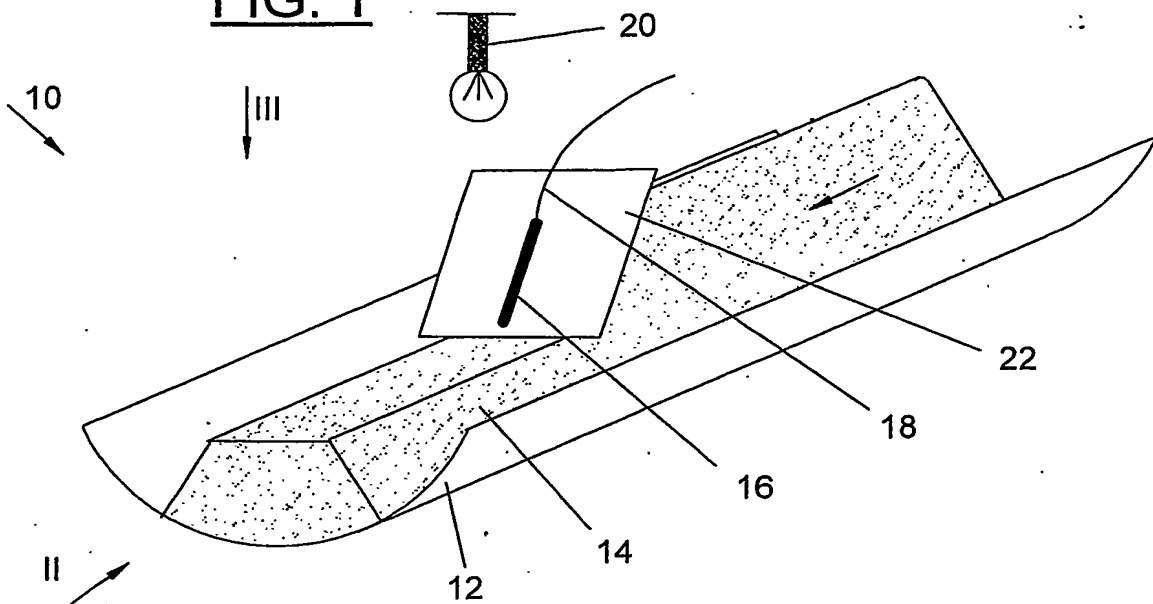
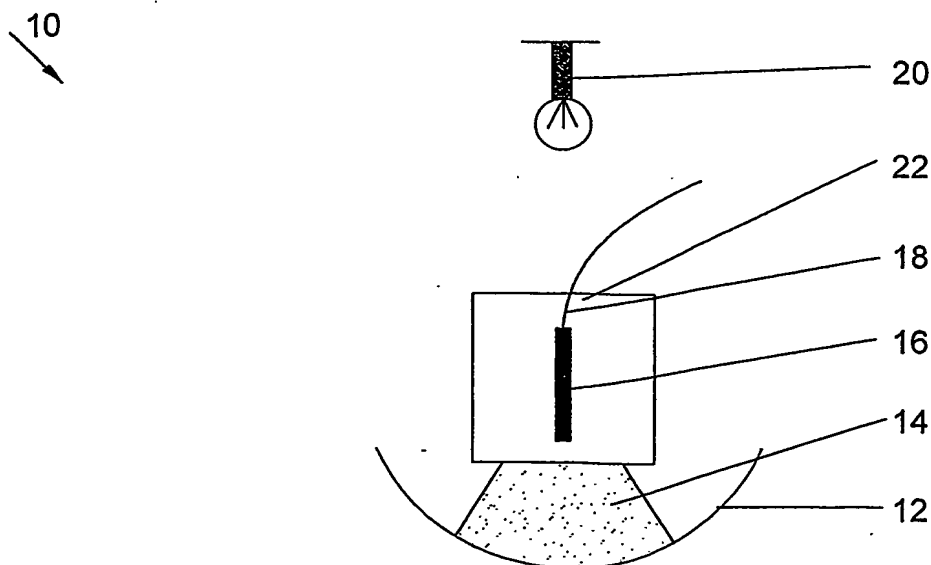


FIG. 2



TSITSIKAMMA TRUST

NO OF SHEETS 2  
SHEET NO 2  
DRG Ref.: 598914

FIG. 3

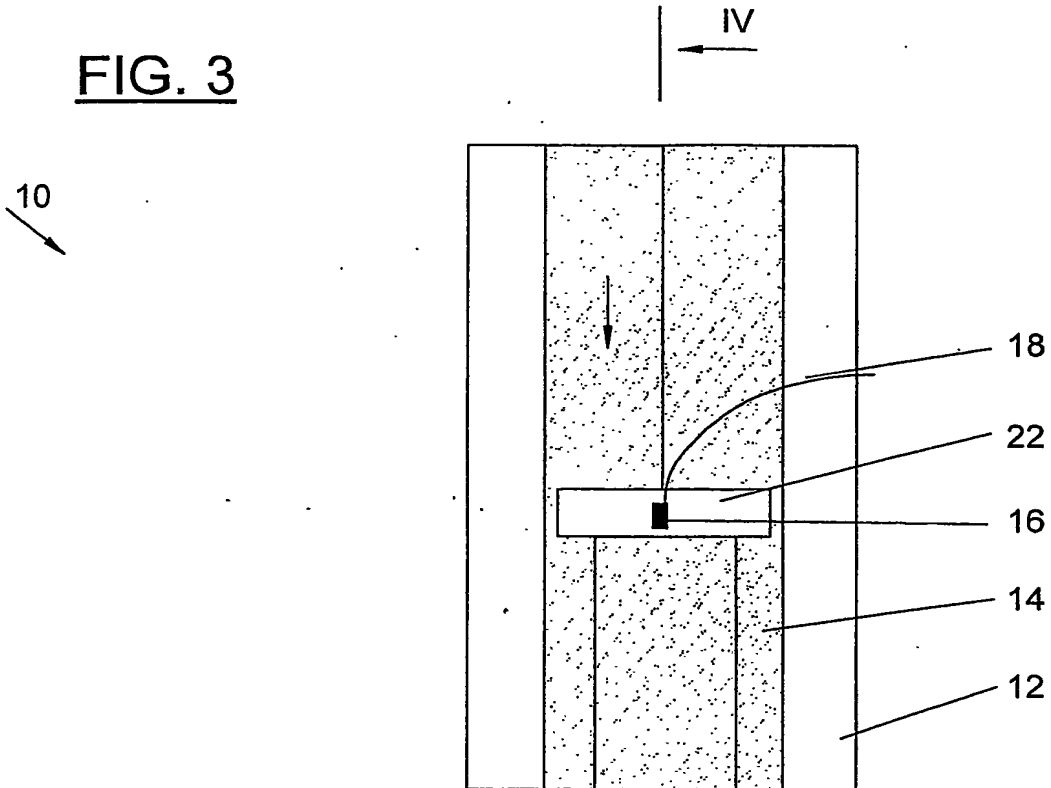


FIG. 4

